Assignment 6.4 p. 269 # 65, 66, 67, 71, 73, 74, 76, 84, 91, 92

65) The enthalpy change for the formation of one mole of a compound is the sum of the enthalpy changes of each element.

$Na_{(s)} + {}^{1}/_{2}Cl_{2(g)} \longrightarrow NaCl_{(s)}$

$H_{2(g)} + {}^{1}/_{2}O_{2(g)} \longrightarrow H_2O_{(l)}$

$6C_{(s)} + 6H_{2(g)} + 3O_{2(g)} \longrightarrow C_6H_{12}O_{6(s)}$

$Pb_{(s)} + S(s) + 2O_{2(g)} \longrightarrow PbSO_{4(s)}$

66) a. $2Al_{(s)} + {}^{3}/_{2}O_{2(g)} \longrightarrow Al_2O_{3(s)}$

b. $C_2H_5OH_{(l)} + 3O_{2(g)} \longrightarrow 2CO_{2(g)} + 3H_2O_{(g)}$

c. $NaOH_{(aq)} + HCl_{(aq)} \longrightarrow NaCl_{(aq)} + H_2O_{(l)}$

d. $2C(s) + {}^{3}/_{2}H_{2(g)} + {}^{1}/_{2}Cl_{2(g)} \longrightarrow C_2H_3Cl_{(g)}$

e. $2C_6H_{6(l)} + 15O_{2(g)} \longrightarrow 12CO_{2(g)} + 6H_2O_{(g)}$ (energy is per 1 mol C_6H_6)

$C_6H_{6(l)} + {}^{15}/_{2}O_{2(g)} \longrightarrow 6CO_{2(g)} + 3H_2O_{(g)}$

f. $NH_4Br_{(s)} \longrightarrow NH_4^+{}_{(aq)} + Br^-{}_{(aq)}$

67) a. $2NH_{3(g)} + 4O_{2(g)} + 2CH_{4(g)} \longrightarrow 2HCN_{(g)} + 6H_2O_{(g)}$

$\Delta H^0 = 2\Delta H_f^0(HCN) + 6\Delta H_f^0(H_2O) - 2\Delta H_f^0(NH_3) - 2\Delta H_f^0(CH_4)$

$\Delta H^0 = 2(135.1) + 6(-242) - 2(-46) - 2(-75) =$ ***- 940. kJ***

67) b. $Ca_3(PO_4)_{2(s)} + 3H_2SO_{4(l)} \longrightarrow 3CaSO_{4(s)} + 2H_3PO_{4(l)}$

$\Delta H^0 = 3\Delta H_f^0(CaSO_4) + 2\Delta H_f^0(H_3PO_4) - \Delta H_f^0(Ca_3(PO_4)_2) - 3\Delta H_f^0(H_2SO_4)$

$\Delta H^0 = 3(-1433) + 2(-1267) - (-4126) - 3(-814) =$ ***- 265 kJ***

c. $NH_{3(g)} + HCl_{(g)} \longrightarrow NH_4Cl_{(s)}$

$\Delta H^0 = \Delta H_f^0(NH_4Cl) - \Delta H_f^0(NH_3) - \Delta H_f^0(HCl)$

$\Delta H^0 = (-314) - (-46) - (-92) =$ ***- 176 kJ***

71) $(-1676) + (-704) + 3(90) + 6(-242) - 3(-295) =$ ***-2677 kJ***

73) $6(-271) - 2(X) - 2(-46) = -1196$ kJ

$-2X = 338$ kJ ***X = -169 kJ/mol***

74) $C_2H_{4(g)} + 3O_{2(g)} \longrightarrow 2CO_{2(g)} + 2H_2O_{(g)}$

$2(-393.5) + 2(-285.8) - \Delta H_f^0(C_2H_4) = -1411.1$

$\Delta H_f^o(C_2H_4) =$ ***52.5 kJ/mol***

76) $CH_3OH_{(l)} + 2O_{2(g)} \longrightarrow CO_{2(g)} + 2H_2O_{(g)}$

$\Delta H^0 = (-393.5) + 2(-285.8) - (-239)$

$\Delta H^0 = \dfrac{-726.1 \text{ kJ}}{1 \text{ mol}} \left| \dfrac{1 \text{ mol } CH_3OH}{32.042 \text{ g}} \right. =$ ***22.7 kJ/g***

84) $\Delta H^0 = 2\Delta H_f^0(KOH) - 2\Delta H_f^0(H_2O)$

$\Delta H^0 = 2(-481) - 2(-286) = -390.\ kJ$

$$\frac{5.00\ g\ K \mid 1\ mol\ K \mid -390.kJ}{\quad\quad\quad\ 39.10\ g\ K \mid 2\ mol\ K} = -24.9\ kJ$$

24,900 J = 1,000.g ΔT (4.18 J/g/°C)

ΔT = 5.96°C Tf = 24.0°C + 5.96°C = ***30.0°C***

91) $\Delta H^0 = 3\Delta H_f^0(C_2H_2) - \Delta H_f^0(C_6H_6)$

$\Delta H^0 = 3(227) - (49) = 632\ kJ$

C_2H_2 is lighter and has a higher heat of formation, so it would produce a lot more energy per gram than C_6H_6.

92)

~~$I_{(g)}$~~ + ~~$Cl_{(g)}$~~ ⟶ $ICl_{(g)}$		ΔH = -211.3 kJ
~~$^1/_2\ I_{2(g)}$~~ ⟶ ~~$I_{(g)}$~~		ΔH = $^1/_2$(151.0) kJ
$^1/_2\ I_{2(s)}$ ⟶ ~~$^1/_2\ I_{2(g)}$~~		ΔH = $^1/_2$(62.8) kJ
$^1/_2\ Cl_{2(g)}$ ⟶ ~~$Cl_{(g)}$~~		ΔH = $^1/_2$(242.3) kJ
$^1/_2\ I_{2(s)}$ + $^1/_2\ Cl_{2(g)}$	⟶ $ICl_{(g)}$	$\Delta H_f^0(ICl)$ = ***16.8 kJ/mol***